IN THE SPECIFICATION:

Please amend the paragraphs from line 2 to line 24 of page 3 as follows:

The above objects of this invention can be achieved with the following technical solution: a crystallizer for casting low melting point metals and their alloy, comprising at least a base, an end mould, mould seats on the end mould, film moulds, a plurality of position-limiting parts ~~straightedges~~ arranged on the inner side of said mould seats in the radiation shape. The shape of the inner side of these ~~straightedges~~ position-limiting parts corresponds with that of the outer periphery of the mould walls of the film moulds. The inner periphery of mould walls corresponds with the outer periphery of the casting. Between the adjacent ~~straightedges~~ position-limiting parts is a vertical gap which forms a slot. The film moulds are fixed on the mould seats by the locating part so that the slot is closed to become the cycle passage of the cooling medium, i.e. medium channel; on the upper end of the medium channel there is a ~~water-supplying~~ medium-supplying port and lower end of the medium channel is communicated with the ~~water~~ drain pipe.

A plurality of ~~straightedges~~ position-limiting parts of present invention may be fixed on the inner side of the mould seats or formed with the mould seats as an integrated body.

A plurality of ~~straightedges~~ position-limiting parts may be further arranged on the inner side of the mould seats vertically.

The inner side of ~~straightedge~~ position-limiting part of present invention is cut by an cutter to form a fringe. The outer periphery of the cutter corresponds with the mould wall of the film mould. Particularly, the sectional shape of the fringe on the inner side of the ~~straightedge~~ position-limiting part is triangle which is truncated by the cutter. The length of truncate arc is 0.5 ~ 6mm. The arc of the two adjacent fringes truncated by cutter is 2 ~ 50mm long.

Please amend the paragraphs from line 15 of page 4 to line 10 of page 5 as follows:

The bottom parts of all the slots on the same mould base are communicated with a passage, and leads to a ~~water~~ drain pipe.

Further, on the end mould may be arranged an upper part which correspond with the inner periphery of mould wall. The end mould is fixed on the mould base which can slide on the end mould; The cylinder cuts the lower part of the inner side of mould seats to form ~~a ring~~ an inner bottom of the mould seat. The bottom of the film mould is clamped between the upper part and the ~~ring~~ inner bottom of the mould seat.

The radius of cylinder is R1, that of the ~~ring~~ inner bottom of the mould seat is R2, that of the upper part is R3, the outer diameter of the cylindrical casting is R4, and the thickness of film mould walls are δ. This invention will define their fit relations as follows:

$$R1 = R2 = R3+\delta = R4+\delta \quad \text{(Formula I)}$$

The parts, such as end mould, mould seats, film moulds and sand cores all take the base as foundation to effect installation relations. After the installation is completed, a mould cavity is formed; meanwhile, slots are closed to become the cooling medium passage, i.e. medium channel. At the upper end of the medium channel there is at least one medium-supplying port, the lower end of medium channel is communicated to the ~~water~~ drain pipe. The ~~water~~ drain pipe is communicated to a medium-discharging port through a soft pipe. The medium-discharging port is fixed in a liquid surface controller. Within the travel lower than the lower end of the medium channel and higher than its upper end, liquid level controller may stop at a pre-determined height or ascend or descend at a pre-determined speed.

Please amend the paragraph from line 1 to line 4 of page 6 as follows:

Each mould ear is pressed tightly between the mould closing fits. The lower sections of mould

walls are pressed tightly between the ~~ring~~ inner bottom of the mould seat and the upper part, the tension of the mould walls and anti-tension of the ~~straightedges~~ position-limiting parts form a pair of force couple for accurate locating, and to achieve rigidity, of the mould walls.

Please amend the paragraphs from line 13 of page 11 to line 13 of page 13 as follows:

As shown in Figs.1—22, the crystallizer of present invention includes at least a base 1, an end mould 2, mould seats 6 and 7 on the end mould 2, film moulds 8 and 9, a plurality of ~~straightedges~~ position-limiting parts 16 arranged on the inner side of said mould seats in the radiation shape. The shape of the inner side of these ~~straightedges~~ position-limiting parts corresponds with that of the outer periphery of the mould walls 8-1, 9-1 of the film moulds 8, 9. The inner periphery of mould walls 8-1, 9-1 corresponds with the outer periphery of the casting. Between the adjacent ~~straightedges~~ position-limiting parts is a vertical gap which forms a slot 17-1. The film moulds 8, 9 are fixed on the mould seats by the locating part so that the slot 17-1 is closed to become the cycle passage of the cooling medium, i.e. medium channel 17; On the upper end of the medium channel 17 there is a ~~water-supplying~~ medium-supplying port 5 and lower end of the medium channel 17 is communicated with the ~~water~~ drain pipe 12. Thus, with the cooling medium being poured into the medium channel, the crystallizer of present invention not only can achieve the bottom-top, sequential thermal diffusion of casting, but also can lead the crystallization interface to go forward rapidly and sequentially from bottom to top, thereby improving the internal quality; Further, a plurality of ~~straightedges~~ position-limiting parts 16 in the inner side of the mould seats 6, 7 can uniformly support and locate the film moulds 8, 9 from multiple positions to avoid the defects prone to deform in the prior art. In addition, the inner sides of a plurality of ~~straightedges~~ position-limiting parts jointly form the shape which corresponds with the outer periphery of the mould walls 8-1, 9-1 of the film mould 8, 9, which makes the film moulds 8, 9 locate through natural leaning without welding, and disassemble easily.

In the present invention, a plurality of ~~straightedges~~ position-limiting parts 16 may be fixed on

the inner side of the mould seats 6, 7 or formed with the mould seats as an integrated body. There is no limitation here.

As shown in the Figs. 3 and 4, a plurality of ~~straightedges~~ position-limiting parts 16 may be further arranged on the inner side of the mould seats 6, 7 vertically.

In order to support the film moulds 8, 9 uniformly and avoid its deformation, the inner side of ~~straightedge~~ position-limiting part 16 is cut by an cutter for form a fringe 21. The outer periphery of the cutter corresponds with that of the mould wall 8-1, 9-1 of the film mould.

As a specific example shown in Figs. 2 and 3, the sectional shape of the fringe 21 on the inner side of the ~~straightedges~~ position-limiting part 16 is triangle which is truncated by the cutter. The length of truncate arc is 0.5 ~ 6mm. The arc of the two adjacent fringes truncated by cutter is 2 ~ 50mm long.

The present invention provides s method for casting using said crystallizer, comprising the following steps:

(a) The melting stock 30 is poured into the mould cavity of said crystallizer at the determined speed. Said determined speed must enable the melting stock liquid levels 35, 38 and 76 in the mould cavity to be higher than the cooling medium liquid level 34 in the medium channel;

(b) When the melting stock fills the bottom part of the mould cavity, and submerges the bottom end of pouring pipe 28-1 up to 10 ~ 30mm in depth, open the water supply box 72, and pour cooling medium 33 into medium channel 17 through a plurality of ~~water-supplying~~ medium-supplying ports 5;

(c) The value R of the longitudinal sections of the tubular casting controls the ascending speed of cooling medium liquid level 34, and R is the speed of the vertical movement of the casting crystal interface;

(d) When the crystallization interface approaches the top of the tubular casting, reduce the value R of cooling medium liquid level 34 or put value R at zero;

(e) The pouring is over. After the casting crystallizes, stop supplying water. A ~~water-discharging~~

medium-discharging port 11 descents below the bottom end of the medium channel through liquid level controller 10, and exhausts the cooling medium in the medium channel;

(f) After the cooling medium is exhausted in the medium channel, the crystallizer is kept in an intermediumte state, and enters an air-cooling time period of 10 to 90 seconds. Then de-moulds, takes out the casting, and enters next cycle.

Please amend the paragraph from line 12 of page 14 to line 3 of page 15 as follows:

As shown in Figs. 9, 10 and 20, the technical process for carrying out the present invention must relay on a pre-state, which is that the melting stock 36, 39 and 81 poured into the mould cavity is above the liquid phase point temperature for a sufficient period of time, that is, before rapid, sequential thermal diffusion reaches a position, the melting stock of the position is not allowed to crystallize. This pre-state may be further described as the following: the melting stock, casting mould, tool-setting-up outside mould and atmosphere are deemed to be a system. After the melting stock is poured into the mould cavity, only small amount of heat is allowed to transfer within the system. The transfer of this small amount of heat is not sufficient to cause the melting stock 36, 39and 81 in the mould cavity or melting stock 36, 39 and 81 in a part of the mould cavity to crystallize, and the melting stock is kept above the liquid phase point temperature for a sufficient period of time. This pre-state is crucial to the technical process of the present invention. Only in this pre-state can cooling medium 33 push crystallization interface 37, 40, 44, 78 and 82 to move from bottom to top. It is exactly the crystallizer of the present invention, which has this pre-state. The mass heat capacity of semi-film mould 8 and 9 is very small, in the process that the system tends to be heat balance, the heat absorbed by the film mould from 25℃ towards 700℃ can only lower the temperature of 10mm-thick melt aluminum by about 41~43℃; The fringe 21 of the ~~straightedge~~ position-limiting part is pointed and thin, so it has an extremely small heat transfer area, and the heat that is transferred to the mould seat before the cooling medium is poured is not sufficient to change the pre-state.

Please amend the paragraphs from line 11 of page 15 to line 4 of page 16 as follows:

As shown in Figs. 1 and 2, the crystallizer comprises such parts as the base 1, end mould 2, medium channel bottom passage 3, sand core 4, ~~water-supplying~~ medium-supplying port 5, mould seats 6 and 7, film moulds 8 and 9, liquid level controller 10, ~~water-discharging~~ medium-discharging port 11, ~~water~~ drain pipe 12, soft pipe 14, and ~~straightedge~~ position-limiting part 16.

~~As shown in Figs. 3 and 4, straightedge~~ Position-limiting part 16 and mould seats 6 and 7 are cast as an integrated body, and the materials used are nodular graphite cast iron. If the section of the tubular casting is used as the projection plane, the projection of the ~~straightedge~~ position-limiting part is arranged in a radiated form, with the source of radiation being on the circular center of the tubular casting, or in other place if necessary. The inner side of the ~~straightedge~~ position-limiting part is a shaped fringe 21, whose sectional shape is triangle with the top truncated by cylinder 22, the length of truncate arc is 0.5 ~ 6mm. The arc of the two adjacent fringes truncated by cylinder 22 is 2 ~ 50mm long. In this embodiment, the arc is 1.6mm long, and the arc on cylinder 22 between the two adjacent fringes is 32.6mm, which is equivalent to that the angle between the two adjacent ~~straightedge~~ position-limiting part is 9°. The virtual cylinder 22 shown with the double dotted line is the cutting trace of the tool in the course of implementation; hence the truncate arc of the fringe 21 and the ~~ring~~ inner bottom of the mould seat 25 are cut out of the same mass. Between the adjacent ~~straightedges~~ position-limiting parts is a vertical gap, i. e. slot 17-1, and on the upper end of each slot there is a ~~water-supplying~~ medium-supplying port 5. At the bottom parts of all the slots on the same mould seat are communicated with the passage 3, and communicated with the ~~water~~ drain pipe 12. On each mould seat there are at least two mould closing fits 57 and 59. On the mould closing fits are a plurality of inserting slots 23.

Please amend the paragraphs from line 18 of page 16 to line 4 of page 18 as follows:

Before moulds being closed, it is necessary to attach the film mould to the mould seat, by plugging the pins into the inserting slots. This attachment is a loose connection only to ensure

that the film mould is not detached from the mould seat after the mould opens, because it needs a small space for free movement before being accurately located. After moulds being closed, the film mould is imbedded in the space made available by accurate fit among upper part 26, ~~ring~~ inner bottom of the mould seat 25, mould closing fits 53, 55, 57 and 59, and ~~straightedge~~ position-limiting part 16.

As shown in Fig. 2, before the position of the film mould is compulsorily determined, the mould wall of the film mould must have a precise arc length, without the need to pay attention to its circularity. When the mould seats 6 and 7, under a mechanic effect, come close along the direction of F1 and F2 and are flexibly press each other, they tightly press the four mould ears 8-2, 8-3, 9-2 and 9-3 of the two film moulds between two pair of mould closing fits, the mould walls 8-1 and 9-1 produce tension, the tension of the mould walls and the anti-tension of ~~straightedge~~ position-limiting part 16 form a pair of force couple for accurate positioning, and to achieve rigidity, of the mould walls.

As shown in Figs. 1 and 2, after the mould walls is positioned, the mould walls 8-1 and 9-1, a plurality of ~~straightedges~~ position-limiting parts 16, ~~ring~~ inner bottom of the mould seat 25, the mould closing fits 53, 55, 57 and 59, ~~water~~ drain pipe 12 jointly form the leakage-free cooling medium passageway, i.e. cooling medium channel 17. The lower end of the medium channel is serially communicated to the ~~water~~ drain pipe, soft pipe and ~~water-discharging~~ medium-discharging port, and then form a connector; the cooling medium in the medium channel circulates in such a direction that water is supplied from the upper end and discharged from the lower end. It must be explained that the diameter of the ~~water~~ drain pipe 12, soft pipe 14 and ~~water-discharging~~ medium-discharging port 11 should be large enough to make the amount of discharged water larger than that of the supplied water. The discharge diameter in this embodiment is 1.25in. If the 20mm liquid lever difference is kept for the cooling medium at the two ends of the loop circuit, the maximum water discharge is $0.025m^3$/min, while the maximum amount of water supply is $0.016m^3$/min. ~~Water-discharging~~ Medium-discharging port 11 is fixed in liquid level controller 10 within the vertical travel which is lower than the lower end and higher than the upper end of the medium channel. The liquid level controller 10 may take the

~~water-discharging~~ medium-discharging port 11 to stop at any height or ascend or descend at any speed. The ascending and descending of the liquid level controller is mechanically driven.

If the ~~water-supplying~~ medium-supplying port 5 keeps on pouring the cooling medium 33 into the medium channel 17, according to the principle of the connector, the cooling medium liquid level 34 in the medium channel and the ~~water-discharging~~ medium-discharging port 11 are always on the same water level. When liquid level controller 10 takes the ~~water-discharging~~ medium-discharging port 11 to ascends and descends, the cooling medium liquid level 34 in the medium channel moves synchronically with the ~~water-discharging~~ medium-discharging port. In this embodiment, the liquid level controller is mechanically driven. Therefore, the height and speed of movement of cooling medium liquid level 34 in the medium channel are precisely controlled by command.

Please amend the paragraphs from line 5 of page 20 to line 24 of page 20 as follows:

As shown in Fig. 13, a ram 75 brings the metal moulds 52 and 62 move forward in the direction of F3 and F4 until they solidly touch and tightly press upper part 26, then the mould seats 6 and 7 bring the film moulds 8 and 9 to come close along the direction of F1 and F2, and are softly press each other, and respectively press mould ear 8-2 between the mould closing fits 53 and 54; press the mould ear 8-3 between the mould closing fits 55 and 56; press the mould ear 9-2 between the mould closing fits 57 and 58; press the mould ear 9-3 between the mould closing fits 59 and 60. A lower section of mould walls 8-1 and 9-1 are tightly pressed in between the ~~ring~~ inner bottom of the mould seat 25 and the upper part 26. According to the above-said principle, the tension of the mould walls and the anti-tension of the ~~straightedge~~ position-limiting part form a pair of force couple to accurately determine the position of the film mould, and to achieve rigidity, of film mould walls 8-1 and 9-1.

As shown in ~~Fig,~~ Fig. 16, an inner cavity 85 needs to be cast on the casting 99, and metal mould cores 66-70 stretch upward from the lower part of the end mould 2.

As shown in Fig. 17, water is uniformly supplied to a plurality of ~~water-supplying~~ medium-supplying ports 5 on the same mould seat by a water distribution box 72. The water distribution box has four functions, i.e., supplying water, adjusting the flow of the water supply, instantly cutting off the water supply, and changing the positive pressure inside the water distribution box into negative pressure and sucking away all the remaining water in the water distribution box.

Please amend the paragraph from line 22 of page 21 to line 26 of page 21 as follows:

The ~~ring~~ inner bottom of the mould seat 25 and cylinder 22 are processed to have accuracy grade 6-7 according to China Standards ; the mould closing fits 53, 55, 57 and 59 of the mould seat, and metal mould sides 54, 58, 56 and 60 are processed to have accuracy grade 5-6 according to China Standards; and the stamping die of the film mould is made to have accuracy grade 5 according to China Standard.

Please amend the paragraph from line 2 of page 23 to line 18 of page 23 as follows:

As shown in Figs. 8 and 19, the melting stock 30 is poured into the mould cavity before the cooling medium 33 is poured into the medium channel. The two steps should not be taken at the same time, nor the latter is done before the former for these reasons. First, when poured into the medium channel, the medium (e.g. water) exists in five ways: gravity water, capillary water, film water, suction water, and crystal water (in the casting paint). The suction water and crystal water will not cause burst of evaporation in the temperature below 900℃, gravity water cannot enter the mould cavity through the tiny gap between the film mould, ~~ring~~ inner bottom of the mould seat and mould closing fits, and only the capillary water and film water slowly spread towards the mould cavity along the film mould. If the melting stock 30 is poured into the mould cavity before the cooling medium 33 is poured into the medium channel, and causes the temperature of the film mould to be higher than 150℃, the capillary and film water will evaporate, under this temperature condition, at a speed higher than its spreading speed to avoid their entering the

mould cavity, so as to prevent the burst of evaporation from taking place inside the mould cavity. Second, when R is more than 25mm/s, if the melting stock 30 is poured into the mould cavity after the cooling medium 33 is poured into the medium channel, it will cause the temperature of the melting stock first poured into the mould cavity drop sharply to form cold shut or cold hole(also referring to as dormer window).

Please amend the paragraphs from line 7 of page 25 to line 14 of page 25 as follows:

As shown in Fig. 21, after the casting finishes crystallization, the water distribution box 72 cuts off the water flow, and sucks away the remaining water. The liquid level controller descends to the lowest position. A air-cooling period continues after exhausting all cooling medium from the medium channel. The air-cooling period for a large or medium-sized tubular casting is somewhere between 10 ~ 90 seconds. The purpose to set the air-cooling period is to dry, with the remaining heat of the casting, the capillary water and film water on the back face of the film moulds 8 and 9, and on the surface of the ~~ring~~ inner bottom of the mould seat 25 and the mould closing fits 53, 55, 57 and 57 to prevent it from spreading on the inner wall of the film mould between two casting cycles.